When air barrier materials are installed on the exterior of the building, not only are they designed to control air leakage into and out of the building enclosure, but they are also designed to resist liquid water that has leaked, or penetrated, the exterior cladding from absorbing into the sheathing and further into the wall assembly.

We have made you aware of a number of industry accepted test methods and standards to evaluate the performance of materials, assemblies and whole building testing when it comes to air leakage. As liquid water infiltration is a major component of moisture-related problems, we felt it necessary to give an overview of the test methods that have been developed over the years to test wall assemblies for liquid water penetration, whether it be in the lab or in the field through mock-up or full wall assembly testing. As it stands, the industry has accepted the fact that a little air leakage is acceptable; however, any water leakage into a structure is deemed unacceptable.

"Laboratory and field performance verification for the water penetration resistance of assemblies and interfaces through properly applied testing are vital components to the quality assurance or commissioning process of a building enclosure. Establishing expectations early in the process is critical and should include identification of performance criteria such as test pressures; definition of "water leakage;" and the roles and responsibilities moving toward resolution if water leakage is observed."

- Keith P. Nelson
  Architect at Intertek-ATI
  - Building Sciences

There are numerous test methods that have been developed, but we wanted to focus on three common methods that are used quite frequently to test for water penetration.

**ASTM E1105**

_Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference_

This test method is a standard procedure for determining the resistance to water penetration under uniform and cyclic static air pressure differences of installed exterior windows, skylights, curtain walls, and doors, when water is applied using a calibrated spray apparatus (spray rack).

This method is specifically written for field testing and combines two procedures, Procedure A and Procedure B. Procedure A is the method that provides a uniform static pressure on the exterior of the wall assembly for a period of 15 minutes. Procedure B cycles this static pressure onto the exterior of the wall assembly, five minutes on, one minute off for a period of three cycles. Failure using either method results if there is any leakage during that 15 minute period.
This method involves the use of a chamber sealed to the interior face of a wall assembly and having air supplied to this chamber to create a lower pressure than that on the exterior of the assembly. Water is then sprayed onto the exterior face of this assembly at a specified rate and any water penetration is then observed and recorded. The water spray system has nozzles spaced on a grid to allow uniform delivery of water to the assembly, allowing wetting of all areas vulnerable to water penetration. The calibrated spray apparatus (spray-rack system) delivers water to the test specimen at a rate of 5.0 U.S. gal./ft.²·h, equivalent to a flow rate of 8” of rain per hour. As this is a test method, there are no requirements listed for testing pressures; however, most specifications are calling for a minimum testing pressure of 6.24 psf; however, this is usually determined by the consultant.

**ASTM E331**

*Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference*

This is typically a laboratory test method and is very similar to Procedure A of ASTM E1105. It is performed under consistent air pressure (static) and involves the application of water to the exterior of the wall assembly in a similar manner as ASTM E1105. The air pressure is lowered on the interior side of the assembly with the sealed air chamber at a test pressure differential of 6.24 psf. The spray rack is again similar to that in ASTM E1105 and is designed to provide the same uniform delivery of water at the same rate of 5.0 U.S. gal./ft.²·h.

**AAMA 501.1**

*Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure*

This is the test method almost everyone recognizes as the “airplane engine test.” Static pressure chambers, such as a chamber similar to that used in ASTM E1105, are sometimes difficult to construct on some wall assemblies to be able to obtain the desired pressure differential.

AAMA 501.1 is often the most effective way to be able to test these types of assemblies. Water penetration testing in the field consists of utilizing a portable wind generator paired with a spray-rack system at the exterior of the wall assembly. An example of such technology is Intertek-ATI’s WOLF. This type of dynamic wind generator may be maneuvered with a telehandler or other boom lift equipment. The equipment can produce sustained wind speeds up to 130 mph and can evaluate a 100 square foot area for water penetration utilizing its integrated spray rack.
In accordance with AAMA 501.1, this equipment may also evaluate areas over 150 square feet when utilizing auxiliary spray racks. When traditional chamber water penetration testing limits a project to a few evaluations per day, a dynamic wind generator can be expected to evaluate over eight well-accessible locations per day.

The spray rack provides the same delivery of water at the face of the wall assembly at a rate of 5.0 U.S. gal./ft.²-h, the same as that stated in ASTM E331 and ASTM E1105. In order to obtain the test pressure differential, the equipment needs to be calibrated to be able to establish the engine speed required to provide the correct wind velocity. For example, to obtain a 6.24 psf, the equivalent wind velocity would be 50 mph. The time frame of the test period is no less than 15 minutes.

With all three of these test methods, a failure is typically reported as a “visual appearance of water observed on the interior surfaces of the wall assembly,” or water that has penetrated the innermost plane of the assembly. The location and quantity of water is recorded. This would not include water that is present in a cavity that is drained to the exterior.

There are a number of other test methods that are available; however, these are the three most common methods that we have encountered. As can be seen, these are assembly test methods and are directed towards areas of a wall assembly that are susceptible to water penetration ... windows, doors, etc.; however, many air barrier materials can also be installed in these types of assemblies and would be subject to the testing so an understanding of these test methods is useful.